IN THE UNITED STATES PATENT & TRADEMARK OFFICE BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Applicant(s):	Kevin R. Keegan et al.	Examiner: I. Akram
Serial No.:	10/801,740	Art Unit: 1795
Filed:	March 16, 2004	Confirmation No. 1846
For:	REFORMER START-UP STRATEGY FOR USE IN A SOLID OXIDE FUEL CELL CONTROL SYSTEM	

APPEAL BRIEF UNDER 37 C.F.R. § 41.37

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

This is an appeal from the final rejection of the Examiner mailed March 30, 2009 rejecting claims 1-19.

The Commissioner is hereby authorized to charge the fee of $540.00 required under 37 C.F.R. § 41.20(b)(2), and any other fee which may be due, or credit any overpayment, to Deposit Account No. 50-4635. If necessary, please consider this submission as a petition for an extension of time and charge any necessary fees that may be due to the Deposit Account listed above.

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I. REAL PARTY IN INTEREST

The subject application is owned by Delphi Technologies, Inc. of P.O. Box 5052, Troy, Michigan 48007-5052.

II. RELATED APPEALS AND INTERFERENCES

There are no known related appeals or interferences which would have any bearing on the Board's decision in the pending appeal.

III. STATUS OF CLAIMS

Claims 1-19 have been rejected and are subject to this appeal.

IV. STATUS OF AMENDMENTS

In view of the Final Office Action mailed on March 30, 2009, Appellants submitted a Response to Final Office Action ("Response") that was filed on June 1, 2009. In the Response, Appellants amended the specification and claims 1, 10 and 15 in the above-referenced patent application. In the Advisory Action mailed on June 17, 2009, the Examiner indicated that the amendments to the patent application were entered for purposes of appeal.

V. SUMMARY OF CLAIMED SUBJECT MATTER

The present appeal relates to pending independent claims 1, 6, 10 and 15, as well as claims 8 and 9. Pursuant to 37 C.F.R. § 41.37(c)(1)(v), Appellants are required to provide a "concise explanation of the subject matter defined in each

of the independent claims involved in the appeal, which shall refer to the specification by page and line number, and to the drawing, if any, by reference characters." Therefore, the concise explanation of the subject matter set forth below is mapped to independent claims 1, 6, 10 and 15, as well as claims 8 and 9. *See* 37 C.F.R. § 41.37(c)(1)(v); MPEP 1205.02.

As set forth in independent claim 1, the present invention is generally directed to a method for pre-heating a hydrocarbon catalytic reformer (14) from a starting temperature to a minimum reforming temperature utilizing an electronic control module (16). *See Specification*, pg. 1, lines 8-11; pg. 3, lines 4-10, 23-27; pg. 4, line 27 through pg. 5, line 7. The method comprises the steps of: a) selecting a fuel type to be combusted; b) determining the latent heat of combustion of the selected fuel type; c) selecting a flow rate of the combustion fuel; d) determining the heat capacity of a catalyst (29) to be heated in the catalytic reformer (14); e) determining a mass of the reformer to be heated; f) determining the starting temperature of the catalyst (29) in the catalytic reformer (14); g) utilizing a software construct to produce the fuel combustion time interval, wherein the construct utilizes the latent heat of combustion, the selected combustion fuel flow rate, the heat capacity of the catalyst (29), the mass to be heated, and the starting temperature, and h) pre-heating the hydrocarbon catalytic reformer (14) using a combustor (26) for the fuel combustion time interval so that the hydrocarbon catalytic reformer (14) reaches the minimum reforming temperature. *See id.* at pg. 4, lines 3-6; pg. 6, lines 3-16; pg. 12, lines 3-11.

As set forth in independent claim 6, the present invention is directed to a catalytic hydrocarbon reformer (14) for making reformate comprising an electronic control module (16) for controlling the flow of hydrocarbon fuel (18) and air (20) into the reformer (14). *See id.* at pg. 3, lines 23-27; FIG. 1. The electronic control module (16) is programmed with a software construct for determining a fuel combustion time interval for pre-heating the hydrocarbon catalytic reformer (14) to a minimum reforming temperature, wherein the fuel combustion time interval is at least dependent on a starting temperature of a catalyst (29) in the reformer (14). *See id.* at pg. 1, lines 8-11; pg. 3, lines 4-10; pg. 4, lines 3-6, 27-28; pg. 6, lines 3-16.

Claim 8 depends from claim 6 and states that the software construct is an algorithm having the linear form $y = mx + b$, wherein y is the minimum reforming temperature, b is the starting temperature, m is an integral of a product of the latent heat of combustion of the fuel times the selected flow rate of the fuel, divided by a product of the mass of the reformer to be heated times the heat capacity of the mass, and x is said fuel combustion time interval. *See id.* at pg. 6, lines 3-13.

Claim 9 depends from claim 6 and states that the fuel cell assembly (12) includes a solid oxide fuel cell. *See id.* at pg. 3, lines 3-27; original claim 9.

As set forth in independent claim 10, the present invention is directed to a computing system having a processor, a memory and an operating environment operable to execute a method for determining a fuel combustion time interval for pre-heating a hydrocarbon catalytic reformer (14) from a starting temperature to

a minimum reforming temperature. *See id.* at pg. 1, lines 8-11; pg. 3, lines 4-10; pg. 4, lines 3-17; pg. 6, lines 3-16. The method comprises the steps of: a) selecting a fuel type to be combusted; b) determining the latent heat of combustion of the selected fuel type; c) selecting a flow rate of the combustion fuel; d) determining the heat capacity of a catalyst (29) to be heated in the catalytic reformer (14); e) determining a mass of the reformer to be heated; f) determining the starting temperature of the catalyst (29) in the catalytic reformer (14); and g) utilizing a software construct to produce the fuel combustion time interval, wherein the construct utilizes the latent heat of combustion, the selected combustion fuel flow rate, the heat capacity of the catalyst (29), the mass to be heated, and the starting temperature. *See id.* at pg. 4, lines 3-6; pg. 6, lines 3-16; pg. 12, lines 3-11.

As set forth in independent claim 15, the present invention is directed to a computer readable medium having computer executable instructions of a wired media type for performing a method for determining a fuel combustion time interval for pre-heating a hydrocarbon catalytic reformer (14) from a starting temperature to a minimum reforming temperature. *See id.* at pg. 1, lines 8-11; pg. 3, lines 4-10; pg. 4, lines 3-26; pg. 6, lines 3-16. The computer executable instructions comprise the steps of: a) selecting a fuel type to be combusted; b) determining the latent heat of combustion of the selected fuel type; c) selecting a flow rate of the combustion fuel; d) determining the heat capacity of a catalyst (29) to be heated in the catalytic reformer (14); e) determining a mass of the reformer to be heated; f) determining the starting temperature of the catalyst (29)

in the catalytic reformer (14); and g) utilizing a software construct to produce the fuel combustion time interval, wherein the construct utilizes the latent heat of combustion, the selected combustion fuel flow rate, the heat capacity of the catalyst (29), the mass to be heated, and the starting temperature. *See id.* at pg. 4, lines 3-6; pg. 6, lines 3-16; pg. 12, lines 3-11.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Claims 6 and 7 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent Publication No. 2002/0071974 to Yamaoka ("the Yamaoka reference").

Claims 1-5 and 10-19 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent Publication No. 2003/0101713 to Dalla Betta ("the Dalla reference") in view of the Yamaoka reference.

Claim 8 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over the Yamaoka reference in view of the Dalla reference.

Claim 9 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over the Yamaoka reference in view of U.S. Patent Publication No. 2002/0150532 to Grieve ("the Grieve reference").

VII. ARGUMENT

Issue 1 – Whether claims 6 and 7 are unpatentable under 35 U.S.C. § 103(a) as being obvious over the Yamaoka reference.

Independent claim 6 is directed to a catalytic hydrocarbon reformer (14) for making reformate comprising an electronic control module (16) for controlling the flow of hydrocarbon fuel (18) and air (20) into the reformer (14). *See id.* at pg. 3, lines 23-27; FIG. 1. The electronic control module (16) is programmed with a software construct for determining a fuel combustion time interval for pre-heating the hydrocarbon catalytic reformer (14) to a minimum reforming temperature, wherein the fuel combustion time interval is at least dependent on a starting temperature of a catalyst (29) in the reformer (14). *See id.* at pg. 1, lines 8-11; pg. 3, lines 4-10; pg. 4, lines 3-6, 27-28; pg. 6, lines 3-16.

The question of obviousness is resolved on the basis of underlying factual determinations including (1) the scope and content of the prior art, (2) any differences between the claimed subject matter and the prior art, (3) the level of skill in the art, and (4) any secondary considerations that may be in evidence. *See Graham v. John Deere Co. of Kan. City*, 383 U.S. 1, 17-18 (1966); *see also KSR Int'l Co. v. Teleflex Inc.*, 127 S.Ct. 1727, 1734 (2007) (stating that the *Graham* factors continue to define the inquiry that controls an obviousness determination). In *KSR*, the Supreme Court emphasized that "the principles laid down in *Graham* reaffirmed the 'functional approach' of *Hotchkiss*, 11 How. 248." *KSR*, 127 S.Ct. at 1739 (citing *Graham*, 383 U.S. at 12).

The operative question in this "functional approach" is "whether the improvement is more than just a predictable use of prior art elements according to their established functions." *KSR*, 127 S.Ct. at 1740. The Supreme Court in *KSR* stated that there are "[t]hree cases decided after *Graham* [that] illustrate this doctrine." *Id.* at 1739. In this instance, "*Sakaraida* and *Anderson's-Black Rock* are illustrative – a court must ask whether the improvement is more than the predictable use of prior art elements according to their established function." *Ex parte Smith*, Appeal No. 2007-1925, pg. 14 (B.P.A.I. June 25, 2007) (quoting *KSR*, 127 S.Ct. at 1740).

Appellants submit that the Yamaoka reference does not teach or suggest a catalytic hydrocarbon reformer including an electronic control module that is programmed with <u>a software construct for determining a fuel combustion time interval for pre-heating the hydrocarbon catalytic reformer to a minimum reforming temperature, wherein the fuel combustion time interval is at least dependent on a starting temperature of a catalyst in the reformer</u> as recited in claim 6. In the Office Action mailed on March 30, 2009 ("Office Action"), the Examiner acknowledges that the Yamaoka reference does not explicitly disclose determining a fuel combustion time interval for pre-heating the reformer (4). *See Office Action*, pg. 6, ¶ 13. However, the Examiner concluded that "it would have been obvious to one having ordinary skill in the art at the time of the invention to *measure* the time necessary [for] heating the catalyst to a reformer temperature . . . ." *Id.* (emphasis added). Appellants first point out that the invention set forth in claim 6 does not relate to *measuring* a fuel combustion time interval for pre-

heating the reformer, as asserted by the Examiner, but is instead uses a *software construct* that is dependent at least in part on a starting temperature of a reformer catalyst to determine the fuel combustion time interval.

The specification of the present patent application recognizes that one approach for determining the fuel combustion time interval is to empirically calculate the amount of time it would take for the surface of the catalyst to reach a minimum reforming temperature. *See Specification*, pg. 2, lines 13-15. However, empirically determining the fuel combustion time interval does not take into account the temperature of the catalyst upon start-up, and therefore the empirical calculation would be inaccurate if the catalyst is still warm from a previous period of operation. *See id.* at lines 16-20.

According to the Examiner, it would have been obvious to one having ordinary skill in the art at the time of the invention to measure the time necessary for heating the catalyst to a reformer temperature because the Yamaoka reference discloses a target temperature setting means, a quantity determinator, measuring time, and the importance of the catalyst temperature. *See Office Action*, pg. 6, ¶ 13. While each of these four aspects mentioned by the Examiner are referred to in the Yamaoka reference, Appellants submit that none of them relate to the determination of a fuel combustion time interval for pre-heating the hydrocarbon catalytic reformer to a minimum reforming temperature based in part on the starting temperature of the reformer catalyst.

The "temperature setting means" and the "quantity determinator" are generally described in paragraphs [0010], [0011], and [0015] of the Yamaoka

reference. Paragraph [0010] of the Yamaoka reference states that a heating device (3) is used to heat raw fuel (11) to a predetermined target temperature, and a raw fuel quantity determinator is used to determine the amount of raw fuel (11) that is supplied to the heating device (3). *See Yamaoka*, ¶ [0010]; FIG. 8. Further, paragraph [0010] of the Yamaoka reference states that a target temperature setting means operates to set the target temperature of the raw fuel (11) on the basis of the quantity of the raw fuel (11) that is supplied to the heating device (3). *See id.* The Yamaoka reference also states that if the quantity of the raw fuel (11) supplied to the heating device (3) increases, the target temperature for the raw fuel (11) also increases. *See id.* at ¶ [0011]; *see also* ¶ [0043] (stating that the quantity of the raw fuel passing through the heating device is dependent upon the load of the fuel cell). It is also disclosed that the quantity of raw fuel (11) fed to the heating device (3) is based on the load applied to the fuel cell (1). *See id.* at ¶ [0044].

In view of the above, Appellants submit that the established function of the "target temperature setting means" and the "quantity determinator" mentioned by the Examiner in the Office Action do not relate to a fuel combustion time interval that is dependent on a starting temperature of a catalyst within the reformer as recited in claim 6. As mentioned above, the quantity determinator determines the quantity of raw fuel flowing through the heating device (which is dependent upon the load applied to the fuel cell), and the target temperature setting means sets the target temperature of the raw fuel within the heating device based on the determined quantity of raw fuel. Neither of these components within the

Yamaoka reference relates to a starting temperature of a catalyst within the reformer.

Paragraph [0015] of the Yamaoka reference relates to a detector for detecting a physical value indicating the quantity of the raw fuel heated by the heating device, and a correcting means for correcting the target temperature based on the physical value detected by the detector. *See Yamaoka*, ¶¶ [0014], [0015]. The established function of the raw fuel quantity detector and the correcting means do not have anything to do with determining a fuel combustion time interval that is dependent upon a starting temperature of a catalyst within the reformer, as set forth in claim 6. The detector merely operates to measure the actual quantity of raw fuel passing through the heating device, which is turn dependent upon a load applied to the fuel cell (1), not to the starting temperature of a catalyst within the reformer. The correcting means adjusts the target temperature for the raw fuel based on the actual measured value, which also does not relate to the starting temperature of a catalyst within the reformer.

The Examiner also notes that time is measured in FIG. 6 of the Yamaoka reference in support of the position that it would have been obvious to one having ordinary skill in the art at the time of the invention to measure the time necessary for heating the catalyst to a reformer temperature. *See Office Action*, pg. 6, ¶ 13. The two graphs shown in FIG. 6 of the Yamaoka reference do not suggest a fuel combustion time interval for pre-heating a hydrocarbon catalytic reformer. Instead, FIG. 6 discloses "a correction value of a quantity of fuel for burning at a transient time when a quantity of raw fuel changes as a step function."

Yamaoka, ¶ [0023]. In other words, the graphs in FIG. 6 of the Yamaoka reference relate to a circumstance where the amount of raw fuel passing through the vaporizing device (7) increases due to, for instance, an increase in load applied to the fuel cell. *See id.* at ¶ [0043]. Given the increased flow of raw fuel passing through the vaporizing device (7), the target temperature of the raw fuel will also increase. *See id.* at ¶¶ [0010], [0011]. In order to increase the temperature of the raw fuel flowing through the vaporizing device (7), the amount of raw fuel injected into the burning device (6) will also need to be increased. *See id.* at ¶ [0027]. The graphs shown in FIG. 6 of the Yamaoka reference relate to introducing a correction value of raw fuel for burning in the burning device (6) as the quantity of raw fuel passing through the vaporizing device (7) changes. The fuel flow is typically represented as a quantity of fuel per unit of time. The Examiner has not provided any explanation of how the time component for the rate of fuel flow relates to the determination of a fuel combustion time interval for pre-heating the hydrocarbon catalytic reformer to a minimum reforming temperature.

In rejecting claim 6, the Examiner also takes into account the discussion in paragraph [0002] of the Yamaoka reference relating to the importance of a minimum activation temperature for a reformer catalyst. *See Office Action*, pg. 2, ¶ 2; pg. 6, ¶ [0013]. Appellants do not dispute that it is known to heat a reformer catalyst to a minimum reforming temperature before reforming can begin. In fact, the background of the invention section of the present patent application acknowledges this on page 2, lines 22-23. The present patent application also

goes on to state that it is of great importance to know when the catalyst surface reaches a temperature sufficient to support catalysis so that the fuel:air ratio may be switched from a fuel-lean mixture to a fuel-rich mixture, otherwise the fuel cell system will be subject to reduced efficiency and durability. *See id.* at pg. 1, line 28 through pg. 2, line 5. Therefore, the discussion in paragraph [0002] of the Yamaoka reference discloses nothing more than what has already been addressed in the background of the invention section of the present patent application.

It is relevant to note that the invention set forth in claim 6 is not only directed to pre-heating the hydrocarbon catalytic reformer to a minimum temperature, but further focuses on a method of determining how long to pre-heat the reformer catalyst. In the background of the invention section of the present patent application, three methods of determining when the catalyst has reached a minimum temperature are discussed. *See Specification*, pg. 2, lines 6-24. One method is to use a temperature sensor on the catalyst surface and waiting for it to indicate that a minimum reforming temperature has been reached. *See id.* at pg. 2, lines 6-9. Another method would be to dispose a temperature probe within the ceramic elements of the reformer. *See id.* at pg. 2, lines 9-12. Yet another approach may be to empirically calculate the amount of time it would take for the surface of the catalyst to reach a minimum reforming temperature. *See id.* at pg. 2, lines 13-15. All of these known methods suffer from some type of drawback as noted in the present patent application, which are addressed using the method in accordance claim 6. *See id.* The discussion in

paragraph [0002] of the Yamaoka reference does nothing more than disclose what was presented in the background of the invention section of the present patent application, and does not eliminate the possibility that the Yamaoka reference utilizes the same prior art methods of determining when the catalyst has reached a minimum temperature that were discussed in the background of the invention section of the present patent application. *See Specification*, pg. 2, lines 6-24.

In the Office Action, the Examiner also made reference to paragraph [0050] of the Yamaoka reference in support of the rejection of claim 6. *See Office Action*, pg. 2, ¶ 2. Paragraph [0050] of the Yamaoka reference relates to controlling the temperature of the raw fuel vapor being sent to the reforming catalyst using the air flow (10). It is further mentioned in paragraph [0050] that the temperature of the raw fuel vapor, if too high, may have a negative affect on the reformate catalyst. This discussion in paragraph [0050] of the Yamaoka reference discloses nothing more than what is set forth in the background of the invention section of the present patent application. *See Specification*, pg. 1, line 22 through pg. 2, line 24. There is nothing disclosed in this portion of the Yamaoka reference that indicates that a starting temperature of the reformer catalyst is used to determine how long to pre-heat the hydrocarbon catalytic reformer so it reaches its minimum reforming temperature. The only temperature mentioned in paragraph [0050] of the Yamaoka reference that relates to the reformer catalyst is its activation temperature, not a starting temperature.

In view of the reasons set forth above, Appellants submit that there has been no evidence presented by the Examiner to conclude that the Yamaoka reference discloses or suggests a fuel combustion time interval that is dependent upon a starting temperature of a catalyst within the reformer. As such, a prima facie case of obviousness has not been established based on the Yamaoka reference, and Appellants request that the rejection of claim 6 be reversed. As claim 7 depends from claim 6, it is requested that the rejection of claim 7 be reversed for the same reasons that were set forth above with respect to claim 6.

Issue 2 – Whether claims 1-5 and 10-19 are unpatentable under 35 U.S.C. § 103(a) as being obvious over the Dalla reference in view of the Yamaoka reference.

Independent claim 1 is directed to a method for pre-heating a hydrocarbon catalytic reformer (14) from a starting temperature to a minimum reforming temperature utilizing an electronic control module (16). *See Specification*, pg. 1, lines 8-11; pg. 3, lines 4-10, 23-27; pg. 4, line 27 through pg. 5, line 7. The method comprises the steps of: a) selecting a fuel type to be combusted; b) determining the latent heat of combustion of the selected fuel type; c) selecting a flow rate of the combustion fuel; d) determining the heat capacity of a catalyst (29) to be heated in the catalytic reformer (14); e) determining a mass of the reformer to be heated; f) determining the starting temperature of the catalyst (29) in the catalytic reformer (14); g) utilizing a software construct to produce the fuel combustion time interval, wherein the construct utilizes the latent heat of

combustion, the selected combustion fuel flow rate, the heat capacity of the catalyst (29), the mass to be heated, and the starting temperature, and h) pre-heating the hydrocarbon catalytic reformer (14) using a combustor (26) for the fuel combustion time interval so that the hydrocarbon catalytic reformer (14) reaches the minimum reforming temperature. *See id.* at pg. 4, lines 3-6; pg. 6, lines 3-16; pg. 12, lines 3-11.

Appellants submit that the combination of the Dalla reference and the Yamaoka reference do not teach or suggest a method for pre-heating a hydrocarbon catalytic reformer comprising the steps of: <u>f) determining a starting temperature of a catalyst in a catalytic reformer; and g) utilizing a software construct to produce a fuel combustion time interval based on, among other factors, the starting temperature of the catalyst of the catalytic reformer</u> as recited in amended claim 1. In rejecting claim 1, the Examiner stated that the Dalla reference discloses the use of fuel type, flow rate, catalyst mass, heat of combustion, and initial temperature of the catalyst and other system constraints for determining the length of time for preheating the reformer catalyst to a minimum reforming temperature. *See Office Action*, pg. 4, ¶ 8. In support of this statement, the Examiner made reference to paragraphs [0052], [0078], [0101], and [0105] of the Dalla reference. *See id.* Appellants submit that none of the cited paragraphs, taken alone or in combination, suggest that a starting temperature of a catalytic reformer is used in a software construct to produce a fuel combustion time interval for pre-heating a catalytic reformer.

Paragraph [0052] of the Dalla reference states in part that "the fuel may be preheated so that it is more readily vaporized upon injection." Therefore, this portion of the Dalla reference refers to preheating the *fuel* so that it is readily vaporized upon injection into the reformer, and is not directed to preheating the *reformer catalyst* to a minimum reformer temperature, as implied by the Examiner in the Office Action.

Paragraph [0078] of the Dalla reference states in part that the catalytic reformer may include a thermal mass, a high heat capacity, and a low pressure drop. There is nothing disclosed in this paragraph of the Dalla reference that provides the basis for concluding that a starting temperature of a catalytic reformer is used in a software construct to produce a fuel combustion time interval for pre-heating a catalytic reformer.

In regard to paragraph [0101] of the Dalla reference, the Examiner pointed out that the Dalla reference discloses that system variables such as the "length of time the fuel processor is operated in rich mode" can be determined. *See Office Action*, pg. 4, ¶ 8; *Dalla*, ¶ [0101]. Appellants submit that the fuel processing referred to in paragraph [0101] is not related to the length of time that the fuel is combusted to heat the reformer (i.e., fuel combustion time interval for pre-heating the catalyst), but is instead related to the length of time the fuel processor (i.e., reformer) is operated in a "rich mode," which relates to a reforming mode (occurring after pre-heating the catalyst). *See Specification*, pg. 1, lines 26-28 (stating that a reformer operates in a fuel rich condition and a combustor operates in a lean fuel to air ratio). Paragraph [0101] does not provide any basis

to conclude that a starting temperature of the catalyst in the fuel processor (i.e., reformer) is taken into consideration when determining how long to use a combustor to pre-heat the reformer to a minimum reforming temperature.

The Examiner also made reference to paragraph [0105] of the Dalla reference in support of the rejection of claim 1. *See Office Action*, pg. 3, ¶ 3; pg. 4, ¶ 8. In particular, paragraph [0105] states in part that the "fuel was combusted on the catalyst and the catalyst temperature rose rapidly as shown by the temperature of the three thermocouples in FIG. 8B." *Dalla*, ¶ [0105]. This portion of the Dalla reference does not disclose how the system disclosed therein determines how long to pre-heat the reformer catalyst so that the reformer catalyst reaches a minimum reforming temperature, and also does not disclose whether or not a starting temperature of the reformer catalyst is used to make the determination. The Examiner appears to be taking the position that since the starting temperature of the gas at the outlet of the reformer catalyst is shown in the graph in FIG. 8B of the Dalla reference, these starting temperatures are used in a software construct to determine a fuel combustion time interval for pre-heating the reformer catalyst. Appellants submit that such a suggestion is not provided in the Dalla reference. Just because the temperature of the gas at the outlet of the reformer is shown in a graph does not mean that a software construct utilizes the starting temperature to calculate a pre-heat fuel combustion time interval.

The Examiner makes further reference to paragraphs [0055], [0064] and FIG. 4 of the Dalla reference in rejecting claim 1. *See Office Action*, pgs. 2-3, ¶

3. Specifically, the Examiner stated that the Dalla reference "explicitly discloses the measuring, compensating for, and changing of the catalyst temperature for the reformation/combustion process." While the temperature of the catalyst may be measured for the purpose of the warm-up and reformation process, Appellants submit that it is possible the Dalla reference is simply using the prior art methods of determining when the catalyst has reached a minimum temperature that were discussed in the background of the invention section of the present patent application. *See Specification*, pg. 2, lines 6-24; *see also supra* at pgs. 15-16. For instance, the Dalla reference could monitor the temperature of the gas at the outlet of the reformer taken by the three thermocouples described in paragraph [0105], wait for the temperature readings to reach the minimum reforming temperature, and then cease the pre-heating phase; this method is similar to the methods described in the background of the invention section of the present patent application, which is dissimilar to the method disclosed in claim 1. *See Specification*, pg. 2, lines 6-12. There is nothing in the Dalla reference to suggest that a software construct is being used to produce a fuel combustion time interval based on, among other factors, the starting temperature of the catalyst of the catalytic reformer.

In rejecting claim 1, the Examiner acknowledged that the Dalla reference does not disclose the details of the software construct set forth in step g) of claim 1, and therefore combines the Yamaoka reference with the Dalla reference. *See Office Action*, pg. 4. Appellants submit that the Yamaoka reference fails to teach

or suggest the step recited in step g) of claim 1 for at least the same reasons that were set forth above with respect to claim 6. *See supra* at pgs. 9-17.

The Examiner also stated in the Office Action that "it would have been obvious to one having ordinary skill in the art at the time of invention to measure the time necessary heating the raw fuel to a reformer temperature in Dalla Betta using the computer of Yamaoka to compensate for the time necessary for the process to occur given the quantity of fuel used and target temperature desired via Yamaoka." *Office Action*, pg. 5, ¶ 9.

Given that the Examiner's statement set forth above is specifically directed to measuring the "time necessary [to heat] the raw fuel to a reformer temperature," it appears that the Examiner is misinterpreting the language of claim 1. The language of claim 1 does not relate to determining how long it will take to heat the raw fuel to a reforming temperature, but instead relates to determining the amount of time that combustion must take place in order <u>to pre-heat the catalytic reformer to a minimum reforming temperature</u>. The amount of time that it will take to heat the raw fuel to a reforming temperature does not necessarily correlate to the amount of the time it will take for the catalytic reformer to reach a minimum reforming temperature. The time intervals for heating the raw fuel compared to heating the catalytic reformer may be based on independent factors. For example, the composition of the raw fuel and the reformer catalyst are different and therefore will heat up at different rates. In addition, the starting temperatures of the reformer catalyst and the raw fuel prior to heating may be different. Therefore, Appellants submit that a time interval for

heating raw fuel to a reformer temperature, as proposed by the Examiner, is not equivalent to a fuel combustion time interval for pre-heating a catalytic reformer to a minimum reforming temperature as set forth in claim 1.

In view of the above, Appellants submit that the proposed combination of the Dalla reference and the Yamaoka reference fails to teach or suggest all of the limitations included in claim 1, and therefore a prima facie case of obviousness has not been established with respect to claim 1. As such, Appellants request that the rejection of claim 1 be reversed. As claims 2-5 depend from claim 1, these claims are not taught or suggested by the combination of the Dalla and Yamaoka references for at least the same reasons that were set forth with respect to claim 1.

Since claims 10-19 also include limitations that are similar to those that were argued above with respect to claim 1, Appellants submit that claims 10-19 are not taught or suggested by the combination of the Dalla and Yamaoka references for at least the same reasons that were set forth with respect to claim 1. It is requested that the rejection of claims 10-19 be reversed.

Issue 3 – Whether claim 8 is unpatentable under 35 U.S.C. § 103(a) as being obvious over the Yamaoka reference in view of the Dalla reference.

Claim 8 depends from claim 6 and states that the software construct is an algorithm having the linear form y = mx + b, wherein y is the minimum reforming temperature, b is the starting temperature, m is an integral of a product of the

latent heat of combustion of the fuel times the selected flow rate of the fuel, divided by a product of the mass of the reformer to be heated times the heat capacity of the mass, and x is said fuel combustion time interval. *See id.* at pg. 6, lines 3-13.

Since claim 8 depends from claim 6, Appellants submit that the Yamaoka reference fails to teach or suggest all of the limitations included therein for at least the same reasons that were set forth above with respect to claim 6. The Dalla reference also fails to teach or suggest the limitation that was lacking in the Yamaoka reference. It is therefore requested that the rejection of claim 8 be reversed.

Issue 4 – Whether claim 9 is unpatentable under 35 U.S.C. § 103(a) as being obvious over the Yamaoka reference in view of the Grieve reference.

Claim 9 depends from claim 6 and states that the fuel cell assembly includes a solid oxide fuel cell.

Since claim 9 depends from claim 6, Appellants submit that the Yamaoka reference fails to teach or suggest all of the limitations included therein for at least the same reasons that were set forth above with respect to claim 6. The Grieve reference also fails to teach or suggest the limitation that was lacking in the Yamaoka reference. It is therefore requested that the rejection of claim 9 be reversed.

Conclusion

For the foregoing reasons, Appellants submit that the references of record fail to teach or suggest every limitation disclosed in claims 1-19, and request that the rejections of these claims be reversed.

Respectfully submitted,

Dated: 8/31/2009

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VIII. CLAIMS APPENDIX

The text of the claims involved in the appeal reads as follows:

1. (Previously presented) A method for pre-heating a hydrocarbon catalytic reformer from a starting temperature to a minimum reforming temperature utilizing an electronic control module, comprising the steps of:

a) selecting a fuel type to be combusted;

b) determining the latent heat of combustion of said selected fuel type;

c) selecting a flow rate of said combustion fuel;

d) determining the heat capacity of a catalyst to be heated in said catalytic reformer;

e) determining a mass of said reformer to be heated;

f) determining said starting temperature of said catalyst in said catalytic reformer;

g) utilizing a software construct to produce said fuel combustion time interval, wherein said construct utilizes said latent heat of combustion, said selected combustion fuel flow rate, said heat capacity of said catalyst, said mass to be heated, and said starting temperature; and

h) pre-heating said hydrocarbon catalytic reformer using a combustor for said fuel combustion time interval so that said hydrocarbon catalytic reformer reaches said minimum reforming temperature.

2. (Original) A method in accordance with Claim 1 wherein said software construct includes an algorithm, software code modules, or interface specifications.

3. (Original) A method in accordance with Claim 1 wherein said software construct is an algorithm having the linear form y = mx + b.

4. (Original) A method in accordance with Claim 3 wherein

y is said minimum reforming temperature;

b is said starting temperature;

m is an integral of a product of said latent heat of combustion times said selected flow rate of said combustion fuel, divided by a product of said mass to be heated times the heat capacity of said mass; and

x is said fuel combustion time interval.

5. (Original) A method in accordance with Claim 1 wherein said minimum reforming temperature is about 500°C.

6. (Previously presented) A catalytic hydrocarbon reformer for making reformate, comprising:

an electronic control module for controlling the flow of hydrocarbon fuel and air into said reformer,

wherein said electronic control module is programmed with a software construct for determining a fuel combustion time interval for pre-heating said hydrocarbon catalytic reformer to a minimum reforming temperature, wherein said fuel combustion time interval is at least dependent on a starting temperature of a catalyst in said reformer.

7. (Previously presented) A catalytic hydrocarbon reformer in accordance with Claim 6 wherein said software construct includes an algorithm, software code modules, or interface specifications.

8. (Previously presented) A catalytic hydrocarbon reformer in accordance with Claim 6 wherein said software construct is an algorithm having the linear form $y = mx + b$, and wherein

y is said minimum reforming temperature;

b is said starting temperature;

m is an integral of a product of the latent heat of combustion of said fuel times the selected flow rate of said fuel, divided by a product of the mass of said reformer to be heated times the heat capacity of said mass; and

x is said fuel combustion time interval.

9. (Previously presented) A catalytic hydrocarbon reformer in accordance with Claim 6 wherein said fuel cell assembly includes a solid oxide fuel cell.

10. (Previously presented) A computing system having a processor, a memory and an operating environment operable to execute a method for determining a fuel combustion time interval for pre-heating a hydrocarbon catalytic reformer from a starting temperature to a minimum reforming temperature, the method comprising:

a) selecting a fuel type to be combusted;

b) determining the latent heat of combustion of said selected fuel type;

c) selecting a flow rate of said combustion fuel;

d) determining the heat capacity of a catalyst to be heated in said catalytic reformer;

e) determining a mass of said reformer to be heated;

f) determining said starting temperature of said catalyst in said catalytic reformer; and

g) utilizing a software construct to produce said fuel combustion time interval, wherein said construct utilizes said latent heat of combustion, said selected combustion fuel flow rate, said heat capacity of said catalyst, said mass to be heated, and said starting temperature.

11. (Original) A computing system in accordance with Claim 10 wherein said software construct includes an algorithm, software code modules or interface specifications.

12. (Original) A computing system in accordance with Claim 10 wherein said software construct is an algorithm having the linear form $y = mx + b$.

13. (Original) A computing system in accordance with Claim 12 wherein

y is said minimum reforming temperature;

b is said starting temperature;

m is an integral of a product of said latent heat of combustion times said selected flow rate of said combustion fuel, divided by a product of said mass to be heated times the heat capacity of said mass; and

x is said fuel combustion time interval.

14. (Original) A computing system in accordance with Claim 10 wherein said minimum reforming temperature is about 500°C.

15. (Previously presented) A computer readable medium having computer executable instructions of a wired media type for performing a method for determining a fuel combustion time interval for pre-heating a hydrocarbon catalytic reformer from a starting temperature to a minimum reforming temperature, comprising the steps of:

a) selecting a fuel type to be combusted;

b) determining the latent heat of combustion of said selected fuel type;

c) selecting a flow rate of said combustion fuel;

d) determining the heat capacity of a catalyst to be heated in said catalytic reformer;

e) determining a mass of said reformer to be heated;

f) determining said starting temperature of said catalyst in said catalytic reformer; and

g) utilizing a software construct to produce said fuel combustion time interval, wherein said construct utilizes said latent heat of combustion, said selected combustion fuel flow rate, said heat capacity of said catalyst, said mass to be heated, and said starting temperature.

16. (Original) A computer readable medium in accordance with Claim 15 wherein said software construct includes an algorithm, software code modules or interface specifications.

17. (Original) A computer readable medium in accordance with Claim 15 wherein said software construct is an algorithm of the linear form y = mx + b.

18. (Original) A computer readable medium in accordance with Claim 17 wherein

y is said minimum reforming temperature;

b is said starting temperature;

m is an integral of the product of said latent heat of combustion times said selected flow rate of said combustion fuel, divided by a product of said mass to be heated times the heat capacity of said mass; and

x is said fuel combustion time interval.

19. (Original) A computer readable medium in accordance with Claim 15 wherein said minimum reforming temperature is about 500°C.

IX. EVIDENCE APPENDIX

There has been no additional evidence submitted, entered by the Examiner, or relied upon by the Appellants in the present appeal.

X. RELATED PROCEEDINGS APPENDIX

There have been no proceedings or decisions rendered by a court or the Board that relate to the present patent application.